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Maddisonia—A New Jumping Spider Genus from Australia (Arachnida: Araneae: Salticidae)

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Abstract. The genus *Maddisonia* is described from Queensland, New South Wales and Western Australia to include three new species: *M. richardsoni, M. whytei* and *M. berbekai*. *Maddisonia richardsoni* is designated the type species.

Keywords: Salticidae; new genus; new species; jumping spiders; taxonomy.

Żabka, Marek. 2014. *Maddisonia*—a new jumping spider genus from Australia (Arachnida: Araneae: Salticidae). *Records of the Australian Museum* 66(4): 217–223.

According to the official databases, 81 genera and about 364 species of Saticidae are known from Australia (Richardson & Żabka, 2011; Platnick, 2014). The lists, however, are far from being complete. The generic revisions published over the last decades have revealed great species diversity; in many cases several times larger than expected. The genera *Opisthoncus, Prostheclina, Lycidas, Maratus, Neon, Clynotis, Cosmophasis, Cytaea, Prostheclina* or the Astieae group are the best examples of this phenomenon (Wanless, 1988; Richardson & Żabka, 2007; Richardson, 2013; Żabka & Waldock, 2012; Waldock, unpubl.; Żabka, unpubl.). The potential sources of new taxa are poorly studied inland and tropical areas (see predictions by Richardson *et al*., 2006). At the moment the genus *Maddisonia* comprises only three species, although future research may reveal greater diversity.

Material and methods

The material for this study was provided by the curators of the Australian Museum, Sydney (AMS), Queensland Museum, Brisbane (QMB) and Western Australian Museum, Perth (WAMP). The types are deposited in original collections. Methods of specimen examination are as described by Żabka (1991). Photographs were taken with a Canon A620 camera and Nikon 800 stereomicroscope, and digitally processed with ZoomBrowser and HeliconFocus software.

Abbreviations used: *AEW*, anterior eyes width; *AL*, abdomen length; *AW*, abdomen width; *CH*, cephalothorax height; *CL*, cephalothorax length; *CW*, cephalothorax width; *e*, embolus; *EFL*, eye-field length; *L*, leg length; *PEW*, posterior eyes width; *p*, projection at the base of embolus; *sd*, sperm duct; *tl*, tegular lobe.

Taxonomy

Maddisonia gen. nov.

Etymology. The name is proposed for Prof. Wayne Maddison (University of British Columbia, Vancouver), the world authority in salticid taxonomy, biogeography and evolution. The name is feminine in gender.

Type species: *Maddisonia richardsoni* sp. nov.

Diagnosis. Small/tiny spiders. Embolus large, cork-screw-like. In some species a projection at the embolus' base present. Seminal reservoir not meandering, tibial apophysis long, single or bifurcate, sometimes with a ventral protrusion. First legs stout, 4th legs longer than 3rd ones.

Description. Spiders below 3 mm long. Cephalothorax pear-shaped, widest at the fovea level, rather low, elongate, posterior thoracic slope starts at ⅔ of thorax's length. Fovea well behind PLE, in the middle of cephalothorax. Clypeus very narrow. Abdomen ovoid, spinnerets not distinctive. Chelicerae with single or two-cuspidate teeth on the posterior margin. First legs stout, with 3 and 2 pairs of ventrolateral spines on tibiae and metatarsi, respectively. Other legs rather delicate, not distinctive, legs 4 longer than legs 3. All legs, especially 2–4 with dark and light bands on particular segments. Palpal organ's embolus large, cork-screw-like, sometimes with a small projection (p) at its base. Sperm duct (sd) not meandering, tegulum ovoid or with lobe (tl). Palpal tibial apophysis long, sometimes bifurcate, with or without additional protrusion. Females not known.

Relationships and distribution. Due to the unique male genitalic structure, the taxonomic position of this enigmatic genus is unclear—at least as long as females are known. The particular species are recorded from single localities (Fig. 5), thus the predictions of their potential distribution are not possible at this stage.

Maddisonia richardsoni sp. nov.

Figs 1, 4A,B

Etymology. The species' name is proposed for Prof. Barry Richardson (Australian National Insect Collection, Canberra) in recognition of his research on salticid taxonomy.

Material examined. Holotype male, New South Wales, River State Forest, 30°33'27"S 152°16'59"E, grassy forest, transect W38, pitfall trap, Jan. 1993, I. Oliver, AMS KS74652.

Diagnosis. Tegulum with lobe (arrow, Fig. 4A), tibial apophysis bifurcate (Figs 1E, 4B).

Description. Male (Fig. 1A–C) cephalothorax brown with darker eye field. Hairiness scant. Abdomen macerated, natural colouration not preserved. Clypeus dark brown. Chelicerae dirty brown with 2 promarginal teeth and single retromarginal two-cuspidate (fissdentate) tooth. Maxillae, labium and sternum dirty brown. Abdomen macerated, natural colouration not preserved. Spinnerets grey. Palpal organ as in Figs 1D, 1E, 4A, and 4B. Dimensions: CL 1.56; EFL 0.62; AEW 0.88; PEW 0.93; CW 1.24; CH 0.57; AL 1.30; AW 0.98; L1 0.98 + 0.63 + 0.63 + 0.385 + 0.385; L2: 0.70 + 0.455 + 0.455 + 0.385 + 0.385, L3: 0.595 + 0.455 + 0.385 + 0.42; L4: 1.05 + 0.49 + 0.70 + 0.525 + 0.35.

Distribution. Known only from type-locality (Fig. 5, triangle).

Maddisonia whytei sp. nov.

Figs 2, 4C,D

Etymology. The name of the species is proposed for Mr Robert Whyte, Australian naturalist, arachnologist and photographer.

Material examined. Holotype male, Queensland, Chelsea Rd Bushland Res., 27°29'S 153°11.5'E, coastal ironbark, open forest, 15 m, 1–31 March 2004, QM party, 51974, QMB S90766.

Diagnosis. Tibial apophysis bifurcate with additional ventral protrusion (see arrow at Fig. 4C). Tegular lobe pointed, embolus' base with projection (see arrow, Fig. 4C).

Description. Male (Fig. 2A–E). Cephalothorax brown, eye field and eye surroundings darker. Whole surface with scattered light hairs, more numerous on sides. Anteriorly with brownish longer hairs. Abdomen blackish with a pattern of lighter spots and dots. Spinnerets dark grey. Clypeus very narrow, brown. Chelicerae vertical, brown, with two pro- and retromarginal teeth. Maxillae, labium and sternum dirty brown. Venter brownish grey. Legs I dirty brown, others with dark grey and light bands. Palpal organ as in Figs 2F, 2G, 4C, ane 4D. Dimensions: CL 1.50; EFL 0.57; AEW 0.88; PEW 0.88; CW 1.09; CH 0.72; AL: 1.24; AW: 0.83; L1: 0.805 + 0.665 + 0.70 + 0.545 + 0.315; L2: 0.525 + 0.420 + 0.420 + 0.245 + 0.28; L3: 0.63 + 0.245 + 0.385 + 0.315 + 0.385; L4: 0.595 + 0.35 + 0.42 + 0.385 + 0.385.

Distribution. Known only from type-locality (Fig. 5, closed-circle).

Maddisonia berbekai sp. nov.

Figs 3, 4E,F

Etymology. The name of the species is proposed for the late Mr Maciej Berbeka, distinguished Polish mountaineer, who died during a pioneering winter ascent of Broad Peak in Karakoram on 6 March 2013.

Material examined. Holotype male, Western Australia, Jarrahdale (Alcoa) Mine area, 31°16'S 116°06'E, vacuum sampled, April 1998, K. E. C. Brennan, WAMP T49432.

Diagnosis. Tegular lobe round, not distinctive, tibial apophysis single, thin and long, embolus cork-screw-shape the most distinctive of all species here.

Description. Male (Fig. 3A–C) cephalothorax brown with darker eye field and eye surroundings, hairiness scant. Abdomen macerated, colouration not preserved. Spinnerets

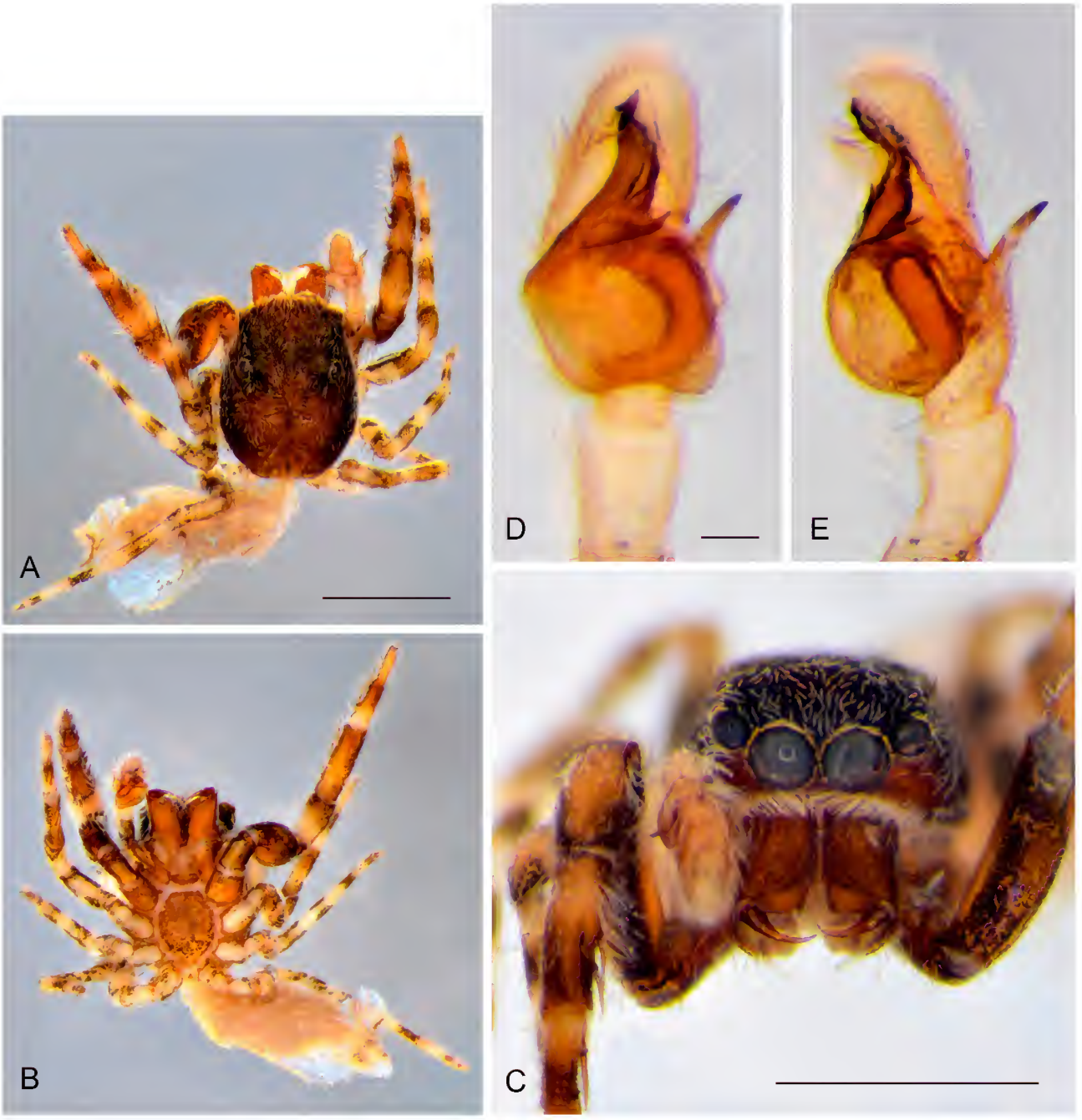

Figure 1. *Maddisonia richardsoni* sp. nov., male holotype. *(A)* dorsal, *(B)* ventral and *(C)* frontal aspects, and *(D–E)* palpal organ. Scales: A and C, 1.0 mm; D, 100 µm.

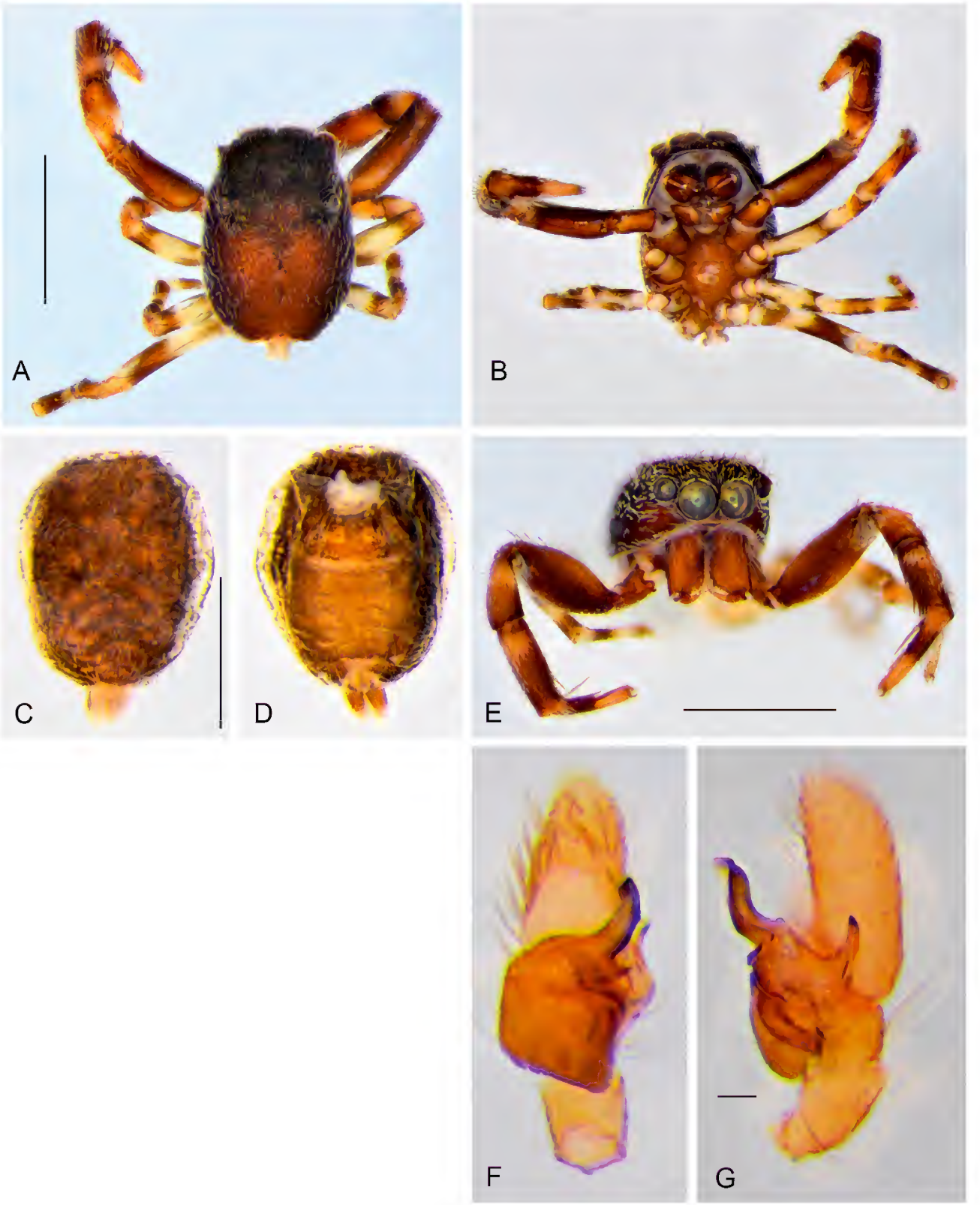

Figure 2. *Maddisonia whytei* sp. nov., male holotype. *(A)* dorsal cephalothorax, *(B)* ventral cephalothorax, *(C)* dorsal abdomen, *(D)* ventral abdomen, *(E)* frontal aspect, and *(F, G)* palpal organ. Scales: A, C, and E, 1.0 mm; G, 100 µm.

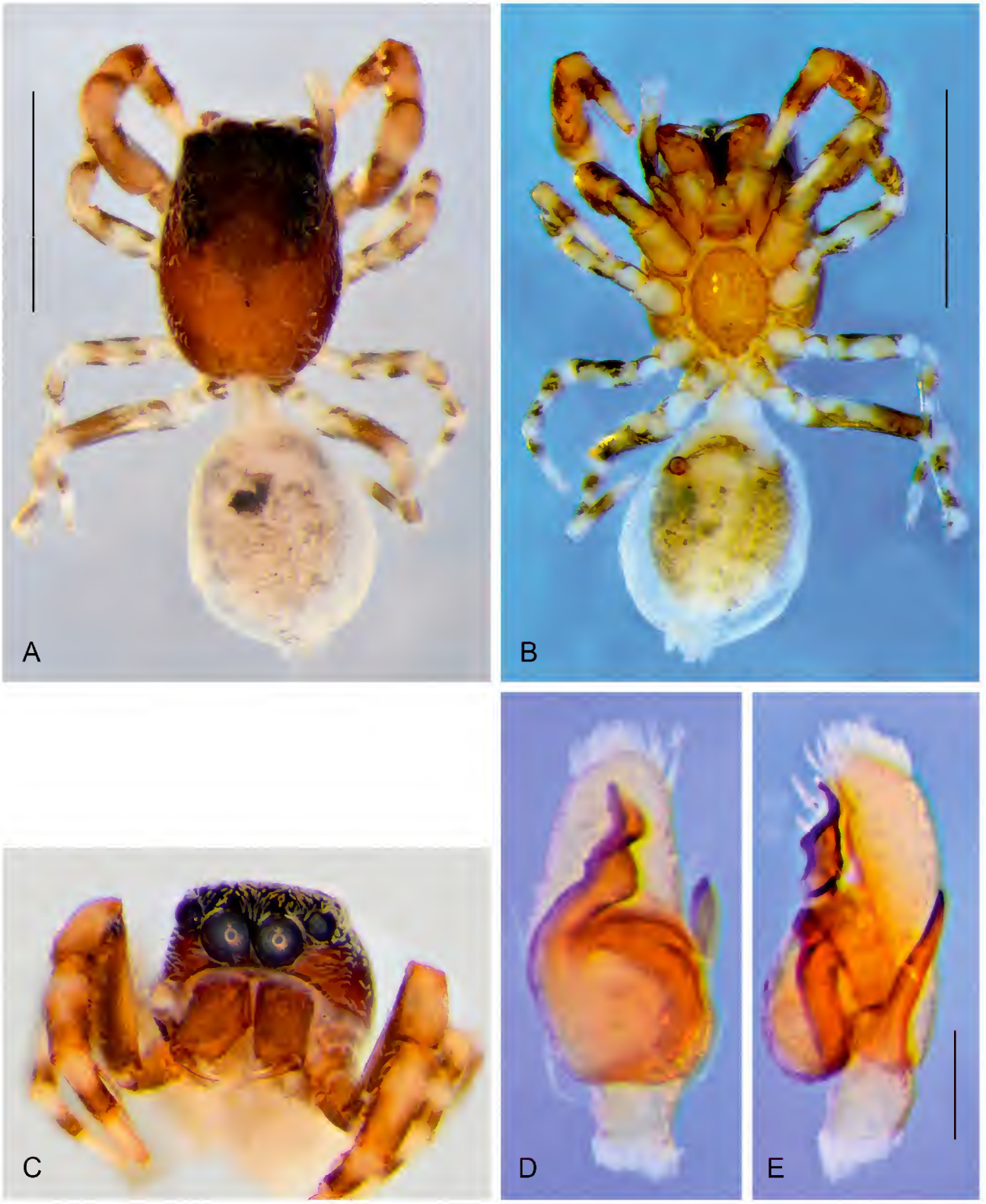

Figure 3. *Maddisonia berbekai* sp. nov., male holotype. *(A)* dorsal, *(B)* ventral, and *(C)* frontal aspects, and *(D, E)* palpal organ. Scales *A–C* 1.0 mm; *D,E* 100 µm.

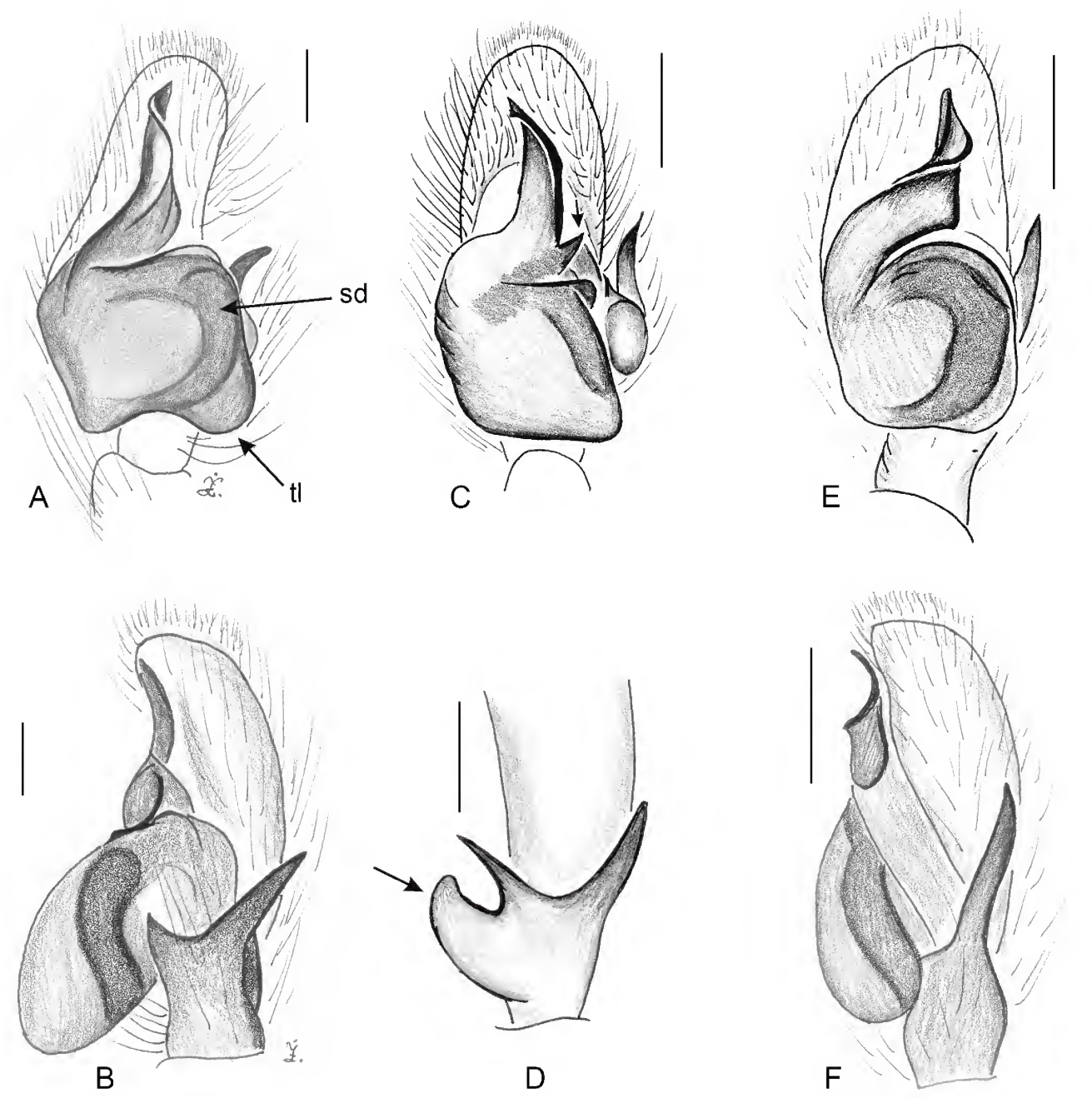

Figure 4. Palpal organs of new *Maddisonia* species. *(A, B) Maddisonia richardsoni* sp. nov., male holotype; *(C, D) Maddisonia whytei* sp. nov., male holotype, *D,* side view of tibia; *(E, F) Maddisonia berbekai* sp. nov., male holotype. Scales 100 μm.

light grey. Clypeus brown. Chelicerae dirty light brown, with two separate teeth and one two-cuspidate tooth on anterior and posterior margins, respectively. Maxillae, labium and sternum dirty light brown. Legs 1 long and massive, pale brown with lighter sides of femora and light and dark grey bands on podomeres. Other legs delicate, with light and dark grey bands. Palpal organ as in Figs 3D, 3E, 4E, and 4F. Dimensions: CL 1.00; EFL 0.384; AEW 0.564; PEW 0.58; CW 0.713; CH 0.58; AL 1.16; AW 0.796; L1: 0.796 + 0.48 + 0.498 + 0.332 + 0.232; L2: 0.464 + 0.394 + 0.348 + 0.332 + 0.232; L3: 0.498 + 0.215 + 0.332 + 0.265 + 0.232; L4: 0.89 + 0.298 + 0.332 + 0.448 + 0.332.

Distribution. Known only from type-locality (Fig. 5, closed-square).

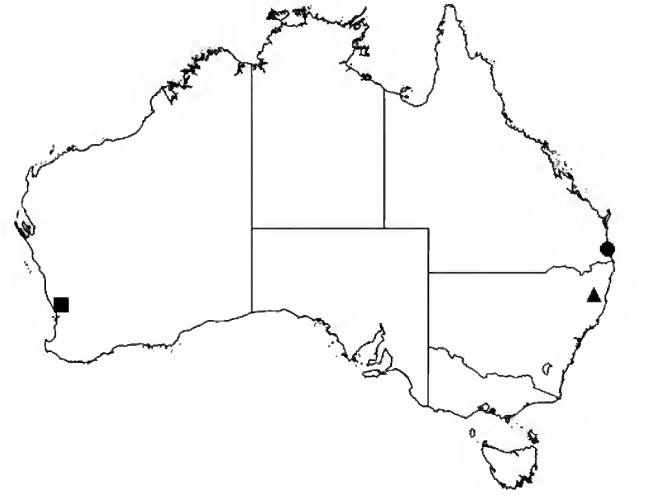

Figure 5. Distributional map of *Maddisonia*: ▲ *M. richardsoni* sp. nov., ● *M. whytei* sp. nov., ■ *M. berbekai* sp. nov.

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Rediscovery of the New Guinea Big-eared Bat *Pharotis imogene* from Central Province, Papua New Guinea

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Abstract. The New Guinea Big-eared Bat *Pharotis imogene* has not been reported since the first and only specimens were collected in 1890 and the species was presumed extinct. We document the capture of one individual of the species from the coastal district of Abau, in Central Province, Papua New Guinea, 120 km east of the only previous known locality at Kamali. We recommend that field surveys be urgently undertaken to assess the conservation status of the species.

Keywords: *Pharotis*; Chiroptera; Vespertilionidae; bat conservation; endemic species; New Guinea

Hughes, Catherine, Julie Broken-Brow, Harry Parnaby, Steve Hamilton, and Luke K.-P. Leung. 2014. Rediscovery of the New Guinea Big-eared Bat *Pharotis imogene* from Central Province, Papua New Guinea. *Records of the Australian Museum* 66(4): 225–232, http://dx.doi.org/10.3853/j.2201-4349.66.2014.1632

The diverse bat fauna of Papua New Guinea includes ten genera and 34 species of pteropids ("fruit bats", Pteropidae) and an assemblage of 25 genera and 57 echolocating species (Bonaccorso, 1998). Of these 35 bat genera, the endemic, monotypic genus *Pharotis* is one of the most poorly known. The New Guinea Big-eared Bat *Pharotis imogene* Thomas, 1914 and the long-eared bats (also called big-eared bats) of the genus *Nyctophilus*, are distinguished from all other Papua New Guinea genera of the family Vespertilionidae by a combination of large ears and a simple nose-leaf immediately posterior to the nostrils (Bonaccorso, 1998). The phylogenetic relationships of *Pharotis* and *Nyctophilus* to each other and to remaining genera of Vespertilionidae remains unclear. Both genera have been placed either in their own subfamily Nyctophilinae (e.g., by Hill & Harrison, 1987) or in the subfamily Vespertilioninae, sometimes as a distinct tribe nyctophilini or in the tribe vespertilionini (see Roehrs *et al.*, 2010).

The largest of the four species of *Nyctophilus* known from Papua New Guinea is distinguished by body size (Flannery, 1995). Previously known as the Greater Long-eared Bat *N. timoriensis* (Geoffroy, 1806), it is now recognized as a distinct endemic New Guinea species *N. shirleyi* Parnaby, 2009. The Small-eared Nyctophilus *N. microtis* Thomas,

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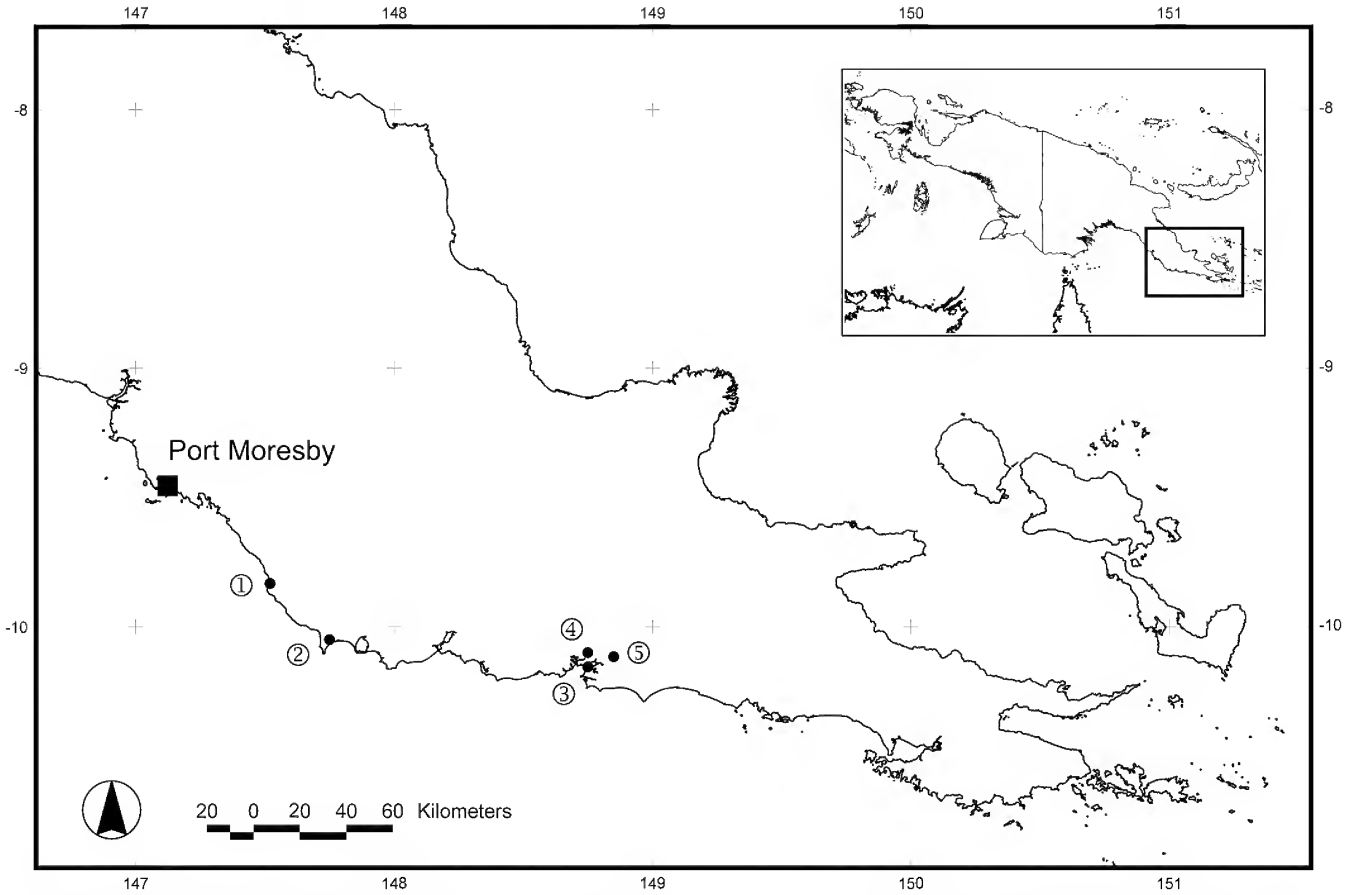

Figure 1. Map indicating localities in the Central Province, Papua New Guinea, mentioned in the text: (1) Kapa Kapa; (2) Kamali; (3) Abau; (4) Bonoabo and (5) Oio village. Bam village (not shown) is c. 2 km north of Oio.

1888 is the most widely distributed and smallest species, differentiated by its relatively small ears which, unlike other Papua New Guinean species of the genus, are not joined above the forehead by a skin membrane (Bonaccorso, 1998). The Northern Long-eared Bat *N. bifax* Thomas, 1915 resembles a smaller version of *N. shirleyi* in external appearance (Parnaby, 2009). It has an extensive Australian distribution but is known from few records from Papua New Guinea (Bonaccorso, 1998). The Small-toothed Nyctophilus *N. microdon* Laurie and Hill, 1954 is endemic to Papua New Guinea (Bonaccorso, 1998). It is distinguished from other Papua New Guinean *Nyctophilus* by its relatively large ears and tragus and in both of these features it resembles *Pharotis imogene* (Parnaby, 2009).

Thomas (1914) proposed the new genus and species *Pharotis imogene* based on a small number of specimens in the Natural History Museum, London, collected by L. Loria from the coastal village of Kamali, Central Province, in November, 1890. These were part of a larger original series in the Museo Civico di Storia Naturale, Genova, Italy consisting of 45 specimens from Kamali, and one specimen from Kapa Kapa, initially identified as *Nyctophilus timoriensis* by Thomas (1897). However, Kamali remained the only authenticated location of *Pharotis imogene* because the identity of the Kapa Kapa specimen was not confirmed as being *Pharotis imogene* by Thomas (1914) and the specimen has not been located in world collections (Flannery, 1995).

There have been no further reports of the New Guinea Big-eared Bat since those originally collected in 1890 and the species was thought to be extinct (Flannery, 1995; Bonaccorso *et al.*, 2008). A specimen from Rogut village, Central Province, Papua New Guinea, thought to be *Pharotis imogene* and reported by Bonaccorso (1998) was examined by one of us (HP) in 1988 and identified as *Nyctophilus microdon*, as noted by Bonaccorso *et al.* (2008). The species is known from very few specimens in world collections and all have originated from Museo Civico di Storia Naturale, Genova, Italy where Loria's specimens were originally housed. Flannery (1995) located six specimens in world collections: three in the Natural History Museum, London, and one each in the Australian Museum, Sydney, the American Museum of Natural History, New York (see Koopman, 1982), and the Zoologisk Museum, Copenhagen. Flannery (1995) reported that all known specimens were adult females, and could all have been obtained from a single roost, which he suspected was a maternity colony.

Broken-Brow and Hughes (2012) captured a bat thought to be either the Small-toothed Nyctophilus *Nyctophilus microdon* or *Pharotis* sp. in the Abau district, 200 km south east of Port Moresby (Fig. 1). Realizing the potential significance of the find, they lodged the specimen in the National Museum & Art Gallery, Port Moresby. In March, 2014, the specimen was loaned to the Australian Museum, Sydney where comparative material enabled confirmation of the specimen as *Pharotis imogene*—the first record of the species since 1890. We discuss the implications of the rediscovery of this species with recommendations for further investigations into its conservation status.

Figure 2. Capture site of *Pharotis imogene* in recently logged rainforest, showing harp trap (photo: Julie Broken-Brow).

Materials and methods

Field work was conducted in the Cloudy Bay Forestry Management Area, a sustainable rainforest logging concession area of some 149,000 ha north-east of Abau, Central Province, Papua New Guinea. Bats were captured in the vicinity of three villages: Bonoabo (10°05'56.1"S 148°44'53.7"E) c. 14 km east of Bam (10°06'11.4"S 148°52'11.7"E) and Oio Village (10°06'47.5"S 148°52'22.4"E), c. 2 km south of Bam. One harp trap and two mist nets were used to capture bats. The harp trap was a standard size, double bank "Austbat" harp trap (Faunatech, Bairnsdale, Victoria). Mist nets were 38 mm mesh, 12×2.6 m black denier nylon nets (Australian Bird Study Association: Mistnet service, Victoria). Mist nets were arranged one above the other on wooden poles, up to 4 meters above the ground. Mist nets were monitored continuously for 3 to 4 hours after sunset. Captured bats were weighed using a Pesola ® spring balance and measured with digital vernier calipers and released during the night to record echolocation calls. The sex and age of individuals was determined and species identifications were determined in the field using Flannery (1995) and Bonaccorso (1998). Site co-ordinates

Figure 3. The live *Pharotis imogene* captured near Oio Village, taken July 2012 illustrating characteristic large ears and tragus (scale, forearm length = 39.6 mm, photo J. Broken-Brow).

were determined using a 60CSx Garmin ® GPS.

As part of a broader study of the impacts of selective rainforest logging on the mammal fauna of the Cloudy Bay Forestry Management Area, the bat component of field work was undertaken between 14 July and 5 August, and from 4–9 November 2012 (Hughes, 2014; and in prep.). One objective of the bat component of the fieldwork was to capture bats and to assemble a *reference call library* of the recorded calls of local microbat species. Recordings of echolocation calls were taken when bats were released to the wild. However, the main focus of the bat work was an ultrasonic census of the bat community to assess impacts of selective logging, and the preferred foraging habitats of the microbat species. Consequently, net and trap sites were located opportunistically and no attempt was made to systematically sample all habitats in the region.

Mist nets and the harp trap were set along creek lines or logging skid (snig) tracks, which were little wider than the harp trap (Fig. 2). The bat trap was moved after two nights at each site, and the mist nets were moved after one night at each site.

The *Pharotis* voucher specimen was preserved in 90% ethanol, without fixation in formalin and lodged with the National Museum and Art Gallery, Port Moresby, on 4 August 2012 and assigned registration number 27464 in March 2014.

The *Pharotis* specimen reported here was compared with *Nyctophilus* material from New Guinea and a *Pharotis imogene* specimen (M2561) in the Australian Museum mammal collection. Specimens of *Nyctophilus microdon* in the Australian National Wildlife Collection, Canberra (CM8525) and two specimens of *N. microdon* on loan to the Australian Museum from the American Museum of Natural History, New York (AMNH 12634–35) were also examined because the latter species is poorly represented in the Australian Museum collection.

Results

A total of 42 individuals of 10 species of bats were captured in 11 harp trap nights in July 2012. Few individuals were captured per species, except for the Lesser Blossom Bat *Macroglossus minimus* (Geoffroy, 1810), a pteropid, which accounted for two thirds of all individuals trapped (see Table 1). Mist nets were set for a combined total of 13 nights in July, and nets were also set in November 2012, but, again, few bats were captured. A male *Macroglossus minimus* and a female Common Blossom Bat *Syconycteris australis* (Peters, 1867) were captured in July, but the only captures in November were a substantial number of Diadem Horseshoe-bats *Hipposideros diadema* (Geoffroy, 1813) (number of individuals not recorded).

An adult female *Pharotis* sp. was captured in a harp trap set on a skid track (Fig. 2), by Catherine Hughes and Julie Broken-Brow on 25 July 2012. The capture site (10°07'39.5"S 148°51'41.1"E) was c. 2.0 km SW of Oio Village, in the Cloudy Bay Forestry Management Area (Fig. 1). The site was in recently logged lowland rainforest. The animal was vouchered (PNGM27464, field number B008) and body measurements taken in the field were: forearm length 39.59

Figure 4. *Pharotis imogene* from near Oio Village, live animal showing nose-leaves and skin membrane joining both ears (scale, least distance between nostril margins = 2.5 mm, photo J. Broken-Brow).

mm; head body length 50.12 mm, tibia length 18.93 mm, ear length (measured from anterior base of the tragus) 24.00 mm, calcar 15.04 mm, body weight 7.70 g. The teats were rudimentary, and it was not clear if the animal was nulliparous.

The *Pharotis* specimen from Oio (Figs 3–5) closely resembles M2561 in the Australian Museum collection, (from the original series from Kamali) in overall body size and has a forearm length of 39.6 mm, comparable to 37.5–39.4 mm given for three females by Bonaccorso (1998). It also closely resembles M2561 in the shape and relative size of the anterior nose-leaf, the well-developed posterior nasal prominence, and the relatively large ears and distinctive tragus shape. Both specimens clearly exhibit key diagnostic features proposed by Thomas (1914) to distinguish *Pharotis* from *Nyctophilus*. These include the convex dorsal margin of the nose-leaf above the nostril (Fig. 6), which contrasts with the median concave margin typical of *Nyctophilus*; a deep pit immediately posterior to the posterior nasal prominence which is absent in *Nyctophilus*, and the lobe on the inner margin of the tragus is located midway between each side of the tragus, rather than located on the outer tragal margin in *Nyctophilus*.

One of the most useful field characters for distinguishing the New Guinea Big-eared Bat from species of *Nyctophilus* is the area of skin between and above the nostrils, which is completely naked (Figs 3–6), but is covered with fine hairs in *Nyctophilus*.

Table 1. Total number of bats captured per species in one harp trap during 11 harp trap-nights during July 2012 in the environs of Bonoabo, Bam and Oio villages, Abau district.

species	females	males
Diadem Horseshoe-bat *Hipposideros diadema* (Geoffroy, 1813)	1	0
Least Blossom Bat *Macroglossus minimus* (Geoffroy, 1810)	10	17
Common Bentwing-bat *Miniopterus australis* Tomes, 1858	2	1
Western Bentwing-bat *Miniopterus magnater* Sanborn, 1913	1	0
Large-footed Mouse-eared Bat *Myotis moluccarum* (Thomas, 1915)	2	2
Small-eared Nyctophilus *Nyctophilus microtis* Thomas, 1888	1	0
New Guinea Big-eared Bat *Pharotis imogene* Thomas, 1914	1	0
New Guinea Pipistrelle *Pipistrellus angulatus angulatus* (Peters, 1880)	1	0
Papuan Pipistrelle *Pipistrellus papuanus* (Peters & Doria, 1880)	1	1
Watts's Pipistrelle *Pipistrellus wattsi* Kitchener, Caputi & Jones, 1986	1	0
Total captures	21	21

Figure 5. *Pharotis imogene* from near Oio Village, live animal showing erect ears (scale, ear length from base of tragus = 24.0 mm, photo Catherine Hughes).

Discussion

The capture of the New Guinea Big-eared Bat in the Abau district extends the known distribution of the species in the Central Province by some 120 km to the east. It also confirms the prediction by Bonaccorso (1998) that the species remains extant. The current IUCN Red List threat status is *Critically Endangered (possibly extinct)*, under criteria *B1a,b (i, ii, iii)* and *D*, i.e. "likely to have a very small population size, and small range size that is subject to a continued decline in extent of occurrence, area of occupancy, and the extent and quality of habitat" (Bonaccorso *et al.*, 2008). The threat status will now need to be reassessed, but the present record might not necessarily alter the status of Critically Endangered under criterion B of the Red List criteria.

The Oio *Pharotis* was captured as part of an ultrasonic census of the local bat community but there were no call sequences positively identifiable as *Pharotis*, however, the species might have cryptic calls that were not distinguished from *Nyctophilus*. The similarities in external morphology (relatively long-ears) and cranial morphology (large auditory bulla) between *Pharotis* and *Nyctophilus* have led to speculation that *Pharotis* might also be a low intensity, substrate-gleaning echolocator (Bonaccorso, 1998). Bat species with this foraging strategy are known to have a higher extinction risk (Jones *et al.*, 2003).

Nothing is known about the ecology of the New Guinea Big-eared Bat. Even broad habitat requirements of this species remain unknown but are suspected to be either lowland sclerophyll woodland or woodland with rainforest patches (Bonaccorso *et al.*, 2008). The Oio individual was trapped in rainforest less than 100 m from the boundary between extensive rainforest to the north and a large expanse of grassland (once a coconut plantation) and was within 12 km of the coast and extensive open country. Many bat species are thought to require spatially dispersed roosting and foraging habitats (Law & Dickman, 1998). However, given that the capture of one animal at a rainforest boundary could be fortuitous, detailed surveys are needed to critically determine whether the species requires the proximity of both rainforest and more open habitats. Open sclerophyll savannah or woodland with or without rainforest patches, thought to be

Figure 6. Close up of the snout region of the alcohol-preserved body of *Pharotis imogene* (PNGM27464) showing diagnostic convex dorsal margin of anterior noseleaf (arrow) and naked skin between and above nostrils. Scale: least distance between nostril margins = 2.5 mm (photo Steve Hamilton).

the habitat of this species (Bonaccorso *et al.*, 2008), was notably absent from the capture site of the species south of Oio, suggesting that rainforest might be an important habitat component for the New Guinea Big-eared Bat.

The photograph of the Oio *Pharotis* in Broken-Brow & Hughes (2012) and Figs 3–5 here, are the only published images of a living animal. The only previously published illustrations of the New Guinea Big-eared Bat, to our knowledge, are of the Australian Museum specimen M2561. These include a black and white photograph of the preserved body (Walker, 1964), and line drawings of the head along with skull photographs in Flannery's 1995 publication. Altringham (2011) also has a line drawing of the nose-leaves shown front on. The only other illustration appears to be the drawing of the baculum (penis bone) of an overlooked immature male specimen in the Natural History Museum, London (Hill & Harrison, 1987). The line drawings provided by Flannery (1995) illustrate the anterior nose-leaf which has inevitably been distorted during prolonged storage. Consequently, the anterior nose-leaf has sagged forward, giving the misleading impression that the dorsal margin is concave in the midline, as in *Nyctophilus*, but the margin is convex, which would be apparent if the nose-leaf was fully erect.

In the most recent review of the biology and conservation status of the New Guinea Big-eared Bat, Bonaccorso *et al.* (2008) emphasize that the species is not known from any protected areas and those authors regard field surveys targeting the species to be one of the highest survey priorities for any bat species in Papua New Guinea. We concur, and accordingly we recommend the following steps to address the conservation status of this species:

1 bat surveys using harp traps are urgently undertaken in the Abau district and adjoining lowland regions, to determine the local distribution and abundance in that area;

2 priority be given to determining whether the species can be identified from echolocation calls, to facilitate acoustic surveys of the species;

3 radio tracking studies be undertaken during different stages of the reproductive cycle to define habitat use, roosting requirements and movements.

A further priority is to establish whether the New Guinea Big-eared Bat is one of a small number of mammal species endemic to the south-eastern peninsula region, or does it occur more widely as suspected by Aplin *et al.* (2010). Surveys should be undertaken in other regions of Papua New Guinea, drawing on insights obtained from steps 1 and 2 above. Such surveys could focus on coastal lowland areas throughout Papua New Guinea, which are amongst the most threatened habitats in the country (Shearman & Bryan, 2011).

Baseline ecological knowledge is lacking for the majority of Papua New Guinea's bat fauna and a third of echolocating species are known from fewer than five localities (Bonaccorso, 1998; Leary & Pennay, 2011). The species taxonomy remains unresolved for much of the bat fauna (Helgen, 2007) and this hinders reliable identification of species. Voucher specimens of bats should be routinely taken during bat surveys to address these deficiencies, as emphasized by Leary & Mamu (2004) and Armstrong & Aplin (2011) and representative specimens should be lodged in the collections of the National Museum, Port Moresby.

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Smenispa irregularis (Bleeker, 1857) (Crustacea: Isopoda: Cymothoidae), a Buccal-attaching Fish Parasite from Australia

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Abstract. *Smenispa irregularis* (Bleeker, 1857) is reported from the host *Acanthopagrus latus* (Sparidae) from Western Australia. The nomenclatural change from *Enispa* Schioedte and Meinert, 1884 to *Smenispa* Özdikem, 2009 is discussed and a full description provided for *Smenispa irregularis*. The species is identified by the strongly vaulted body shape, pereonites 1 and 2 arching anteriorly, cephalon embedded in pereonite 1, lateral margins of pereonites subparallel, and the lateral margins of pleonites subparallel and arching posteriorly.

Keywords. Crustacea, Isopoda, Cymothoidae, *Smenispa irregularis*, taxonomy, Western Australia, *Acanthopagrus latus*

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The genus *Smenispa* Özdikem, 2009 (previously known as *Enispa* Schioedte & Meinert, 1884) is one of the smaller and least known of the cymothoid genera with only two species listed in *The World Register for Marine Species* (Bruce, 2013). There have been few records of *Smenispa* since its original description (as *Enispa* Schioedte & Meinert, 1884) and its host preferences and geographical distribution remain little known.

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Smenispa convexa (Richardson, 1905) was first recorded from Panama from an unknown host (Richardson, 1905). Fifty years later, Menzies *et al.* (1955) thoroughly reviewed the life history and host-parasite relationship of *Smenispa convexa* (as *Livoneca convexa*). The species was reported from Pacific bumper *Chloroscombrus orqueta* Jordan & Gilbert, 1883 from the Gulf of Panama, Gulf of Guayaquil and Gulf of Fonseca (Fig. 1). Brusca (1981) designated

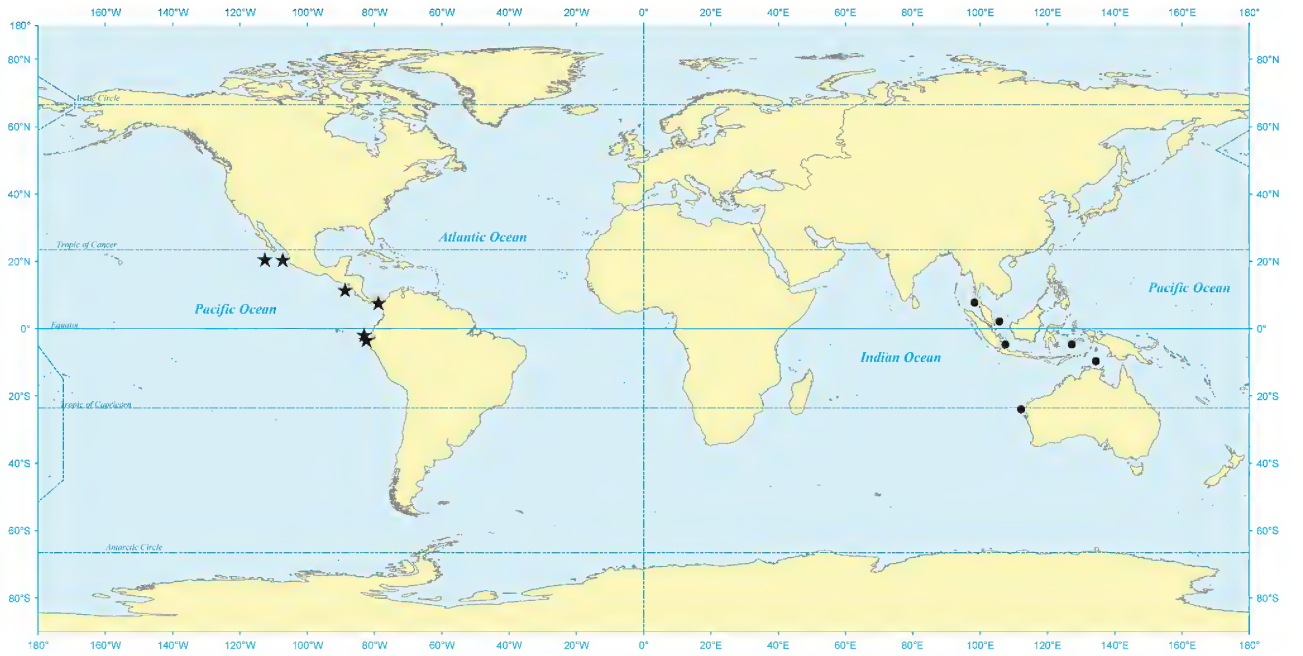

Figure 1. World map of the distribution of *Smenispa irregularis* (circles) and *Smenispa convexa* (stars).

a neotype from the host *Serranus* sp., provided detailed descriptions of both the female and male, and summarized its distribution (Fig. 1).

Smenispa irregularis (Bleeker, 1857) was recorded from Ambon Island (Bleeker, 1857), Singapore and Thailand (Schioedte & Meinert, 1884), Jakarta Bay (Trilles, 1979), Arafura Sea, Northern Territory (Bruce, 1990) and the present material is from Carnarvon, Western Australia (Fig. 1). Bruce (1990) provided the first modern redescription of *Smenispa irregularis*, albeit with limited material at hand.

This paper reports on the occurrence of *Smenispa irregularis* from Western Australia on yellowtail seabream *Acanthopagrus latus* (Houttuyn, 1782) with further description and illustration of the female and male of the species.

Materials and methods

Specimens were obtained from the Australian Museum. Pencil drawings were made using a camera lucida attached to a Leica MZ125 stereomicroscope, scanned and digitally illustrated using Adobe Illustrator and WACOM Intuous 3 drawing pad. Descriptions were prepared in DELTA (Descriptive Language for Taxonomy) (Coleman *et al.*, 2010) using a general Cymothoidae character set. Host nomenclature and distribution was obtained from *Fishbase* (Froese & Pauly, 2013).

Taxonomy

Suborder Cymothoida Wägele, 1989

Superfamily Cymothooidea Leach, 1814

Family Cymothoidae Leach, 1814

Genus *Smenispa* Özdikem, 2009

Enispa Schioedte & Meinert, 1884: 292.—Bruce, 1990: 282.
Smenispa Özdikem, 2009: 611.
Not *Enispa* Walker, 1866: 1121 (Lepidoptera, Noctuidae).

Type species. *Cymothoa irregularis* Bleeker, 1857, by monotypy.

Remarks. The key diagnostic characters of the genus are the strongly vaulted body; cephalon embedded in pereonite 1; antennula shorter than antenna, bases set wide apart; pereon and pleon are co-linear with sub-parallel lateral margins; pereopods lack carina on basis and the endopods of pleopods 3–5 have large folds. Bruce (1990) provided a detailed diagnosis for the genus.

The name *Enispa* Schioedte & Meinert, 1884 was found to be a junior homonym of the valid genus name *Enispa* Walker, 1866 (Lepidoptera) by Özdikem (2009), who proposed the new name *Smenispa* (derived by adding the first two letters of the names Schioedte and Meinert to the original name).

The overall similarity of the general somatic morphology to other buccal-attaching genera resulted in the species being placed, at times, in the genus *Cymothoa* Fabricius, 1793, and *Livoneca* Leach, 1818 especially as both genera have antennae bases set wide apart. *Cymothoa* generally have narrowly rounded uropod apices and pleonite 1 is narrower and less wide than pleonites 2–5. Early accounts (e.g., Bleeker, 1857; Haller, 1880) showed only the dorsal view of a female, and Schioedte & Meinert (1884) included dorsal and ventral views of both the female and male. The genus remained effectively ignored until Bruce (1990) redescribed the species from the type specimens and gave a revised generic description, showing that appendage and brood pouch morphology clearly aligned the genus with genera such as *Anilocra* Leach, 1818 and *Nerocila* Leach, 1818.

Bruce (1987) placed the genus within the Anilocrinae (mostly external attaching genera) on the basis of cephalon, brood pouch and pleopod morphology, Bruce (1990) later suggested avoiding the name Anilocrinae as position on the host and associated body shape was not a reliable indicator of phylogenetic relationships between genera. Ketmaier's *et al*. (2008) molecular dataset (based on a small number of species, inevitably had strange pairings) provide strong support to Bruce's (1990) warnings. In particular, we do not support the hypothesis of a "linear" evolutionary pathway that starts with externally attaching forms (Anilocrinae) and ends up with gill-mouth dwellers (Livonecinae + Cymothoinae) as previously suggested by Brusca (1981).

Smenispa irregularis (Bleeker, 1857)

Figs 1–5

Cymothoa irregularis Bleeker, 1857: 34, pl. 2, figs. II.—Miers, 1880: 462.—Gerstaecker, 1882: 261.
Cymothoa paradoxa Haller, 1880: 378, pl. 18, figs. 5–7.—Gerstaecker, 1882: 261.
Enispa irregularis.—Schioedte & Meinert, 1884: 293, pl. 11, figs. 1–4.—Nierstrasz, 1915: 95.—Nierstrasz, 1931: 137.—Trilles, 1979: 259, pl. 1, figs. 6; 1994: 152.—Bruce, 1990: 282, figs. 24–25.

Type material. Syntypes 2 ♀ (ovigerous 19 mm, 23 mm), Rijksmuseum van Natuurlijke Historie (RMNH 62), "Oost Indie", coll. P. Bleeker (not examined).

Material examined. **Western Australia:** 1 ♀ (24 mm, ovig., damaged pleonite, mouthpart and pereopods), 1 ♂ (9 mm), AM P89833, from Carnarvon, 24°53'S 113°40'E, 1982, from buccal cavity of yellowfin seabream *Acanthopagrus latus* (Houttuyn, 1782).

Diagnosis. *Female*. Cephalon embedded in pereonite 1. Pereonite 1 anterior margin trilobed; lateral margins of pereonites subparallel, pereonites 1 and 2 arching anteriorly, pereonite 2 posterolateral margins produced, lateral margins of pleonites subparallel and arching posteriorly, pleotelson subtruncate and endopod larger than exopod. *Male*. Body similar to female; cephalon dorsally visible; pleon width 0.6 pereonite greatest width; pleopod 2 appendix masculina slender, apex distally acute, length 0.8 endopod length, not reaching beyond exopod; pleopod 2 endopod length 1.9 width, medial margin produced, slightly extending exopod; exopod length 1.5 width, proximal lateral margin strongly produced.

Description. **Female**. *Body* length 2.0 greatest width, dorsal surface smooth appearance, widest at pereonite 5, most narrow at pereonite 1. *Cephalon* length 1.0 width, visible from dorsal view, embedded in pereonite 1; *frontal margin* ventrally folded. *Eyes* indistinct, eye width 0.1 width of cephalon. *Antennula* shorter than antenna, comprised of 8 articles; article 2 length 2.0 article 1 length; not extending to posterior margin of eye. *Antenna* comprised of 12 articles, last article terminating without setae.

Pereonite margins smooth, increasing in width from pereonites 1–5, pereonite 1 length 0.3 width, anterolateral margin produced, extending past cephalon; pereonite 5 widest, length 0.2 width; pereonite 6 and 7 lateral parts with posteriorly produced lobes. *Coxae 2–3* posteroventral angles produced; 4–7 not acute posteriorly, with oblique carina. *Pleonites* visible in dorsal view; lateral margins arching posteriorly. *Pleonite 1* posterolateral angles not hidden behind pleonite 2; pleonites 1–5 subparallel. *Pleotelson* length 0.5 anterior width, dorsal surface smooth, anterolateral margins weakly convex, posterior margin straight, without median point.

Pereopods 1–7 dactylus narrowly curved, merus and carpus of similar length, not produced. *Pereopod 1* basis length 1.8 greatest width; ischium length 0.6 basis length; merus proximal margin without bulbous protrusion; carpus with straight proximal margin; propodus length 1.3 width. *Pereopods 2* and *3* similar to pereopod 1, gradually increasing in size. *Pereopod 6* basis length 2.0 greatest width, ischium length 0.4 basis length. *Pereopod 7* basis length 1.6 greatest width; ischium length 0.6 basis length, merus length 0.4 ischium length, merus length 0.7 width; carpus length 0.1 ischium length, carpus length 0.3 width.

Pleopods (damaged), without setae. *Uropod* half the length of pleotelson, protopod length 0.8 endopod, protopod lateral margin without setae; rami not extending beyond pleotelson, apices bluntly rounded. *Endopod* apically not bifid, length 3.0 greatest width, lateral margin proximally convex, distally concave. *Exopod* shorter than endopod, length 2.8 greatest width, apically not bifid, terminates without setae.

Male. Body subparallel, length 2.2 width. *Cephalon* length 1.5 width, visible from dorsal view, not embedded in pereonite 1. *Eyes* distinct and well developed. *Pereonites* without posterior lateral lobes, similar in length. *Antennula* comprised of 8 articles. *Antenna* comprised of 10 articles, last article terminating without setae, extending to posterior of pereonite 1. Anterior margin of cephalon subtruncate, without small median point. *Mandibular process* present, covered in pectinate scales, article 3 with fine setae. *Maxillula* with 3 narrow spines. *Maxilla* mesial lobe with 2 recurved spines, partly fused to lateral lobe with 2 recurved spines. *Maxilliped* article 3 with 2 recurved robust setae. Lateral ends of pleonites less developed than in female. *Pereopods 1–7* similar to female; dactylus length 0.8 basis length.

Pleopods without setae, without lobes on pleopods 1–2. *Pleopod 1* exopod length 1.3 width, lateral margin weakly convex, mesial margin weakly produced; endopod length 1.7 width, lateral margin straight, mesial margin slightly convex; protopod width 4.0 length. *Pleopod 2* endopod length 1.9 width, medial margin produced, slightly extending exopod; exopod length 1.5 width, proximal lateral margin strongly produced; *appendix masculina* slender, apex distally acute, length 0.8 endopod length, not reaching beyond exopod. *Pleopods 2–5* with basal projections; exopods proximal lateral border extending beyond protopod; endopods proximal mesial boarder extending past protopod boarder, endopod dorsal with large medial fleshy folds. *Uropods* dorsally visible, slightly hidden by pleotelson.

Colour. Present specimens (female and male) dark orange brown. Bruce (1990) reported pale tan in the Northern Territory specimen with no chromatophores present.

Size. Non-ovigerous female 24 mm, male 9 mm. Other reports include Bleeker (1857) (female: 28 mm), Schioedte & Meinert

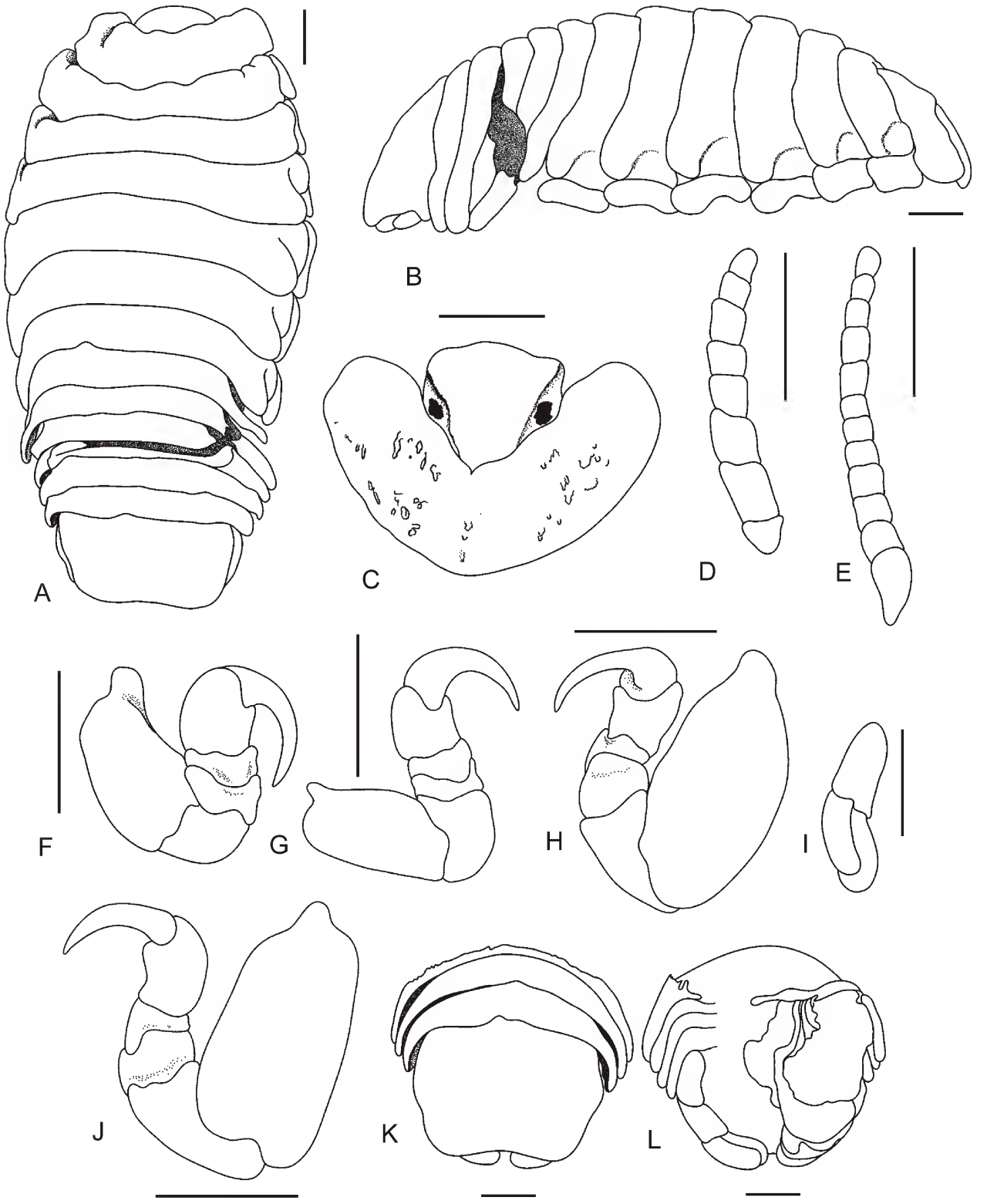

Figure 2. *Smenispa irregularis*, ovigerous female (24 mm) (AM P89833). *(A)* dorsal view of body; *(B)* lateral view of body; *(C)* front view of pereonite 1 and cephalon; *(D)* antennula; *(E)* antenna; *(F)* pereopod 1; *(G)* pereopod 2; *(H)* pereopod 6; *(I)* uropod; *(J)* pereopod 7; *(K)* dorsal view of pleotelson; *(L)* ventral view of pleotelson. Scales = 2 mm, except D, E = 0.5 mm.

(1884) (ovigerous female: 20–24 mm non ovigerous female 22 mm; male 5–8 mm), Haller (1880) (ovigerous female: 18 mm), Trilles (1979) (ovigerous female: 19 mm; males 16 mm).

Hosts. Material from yellowfin seabream *Acanthopagrus latus*. Previous records are Indian halibut *Psettodes erumei* (Bloch & Schneider, 1801) Schioedte & Meinert (1884) and *Caranx carangus* (Bloch, 1973) Haller (1880). Miers (1880) quoted Bleeker (1857) "… is common on fishes in the sea of Amboina Island".

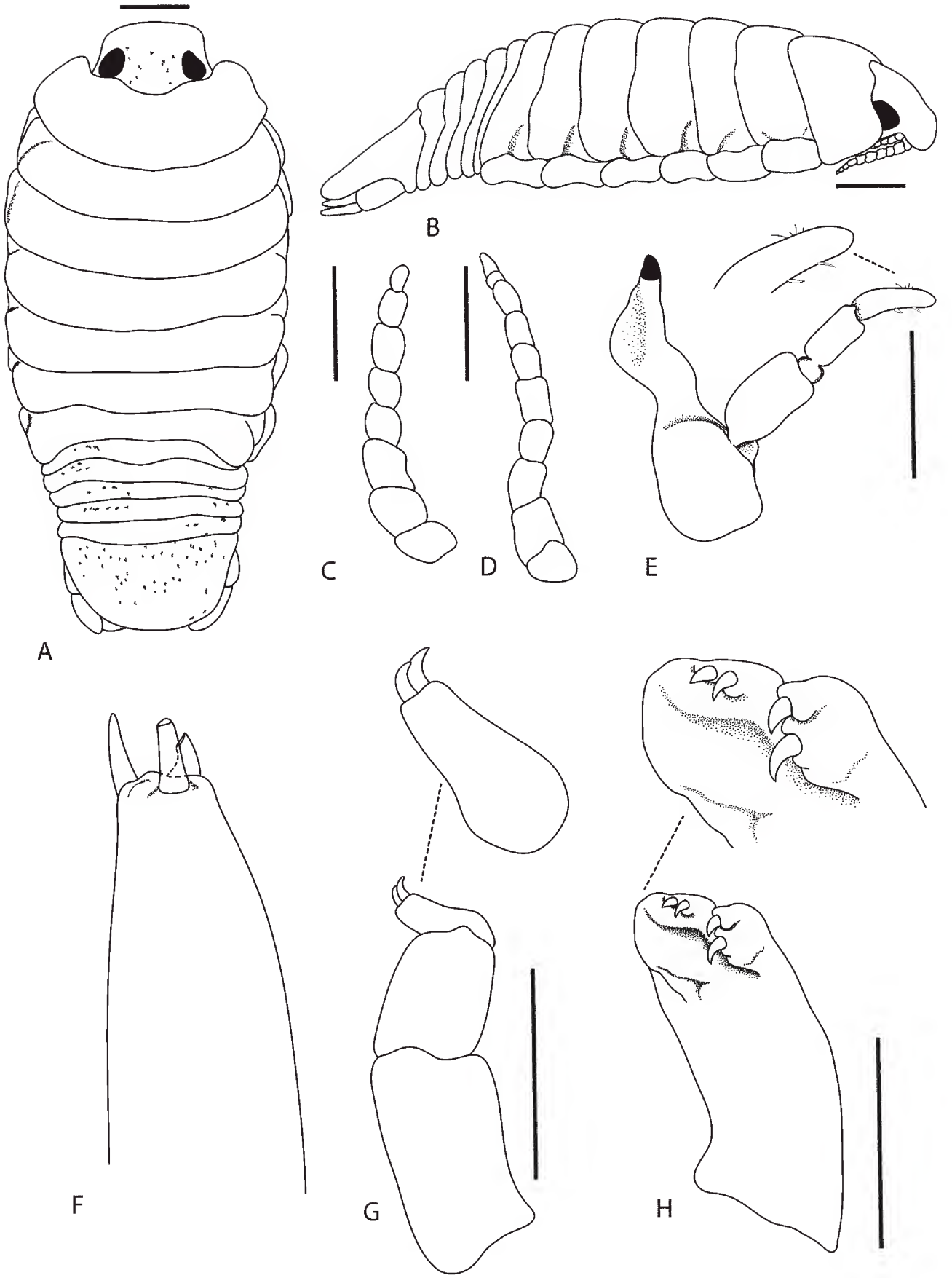

Figure 3. *Smenispa irregularis*, male (9 mm) (AM P89833). *(A)* dorsal view of body; *(B)* lateral view of body; *(C)* antennula; *(D)* antenna; *(E)* mandible; *(F)* maxillula; *(G)* maxilliped; *(H)* maxilla. Scales: A, B= 1 mm; C, D = 0.5 mm; E–H = 0.25 mm.

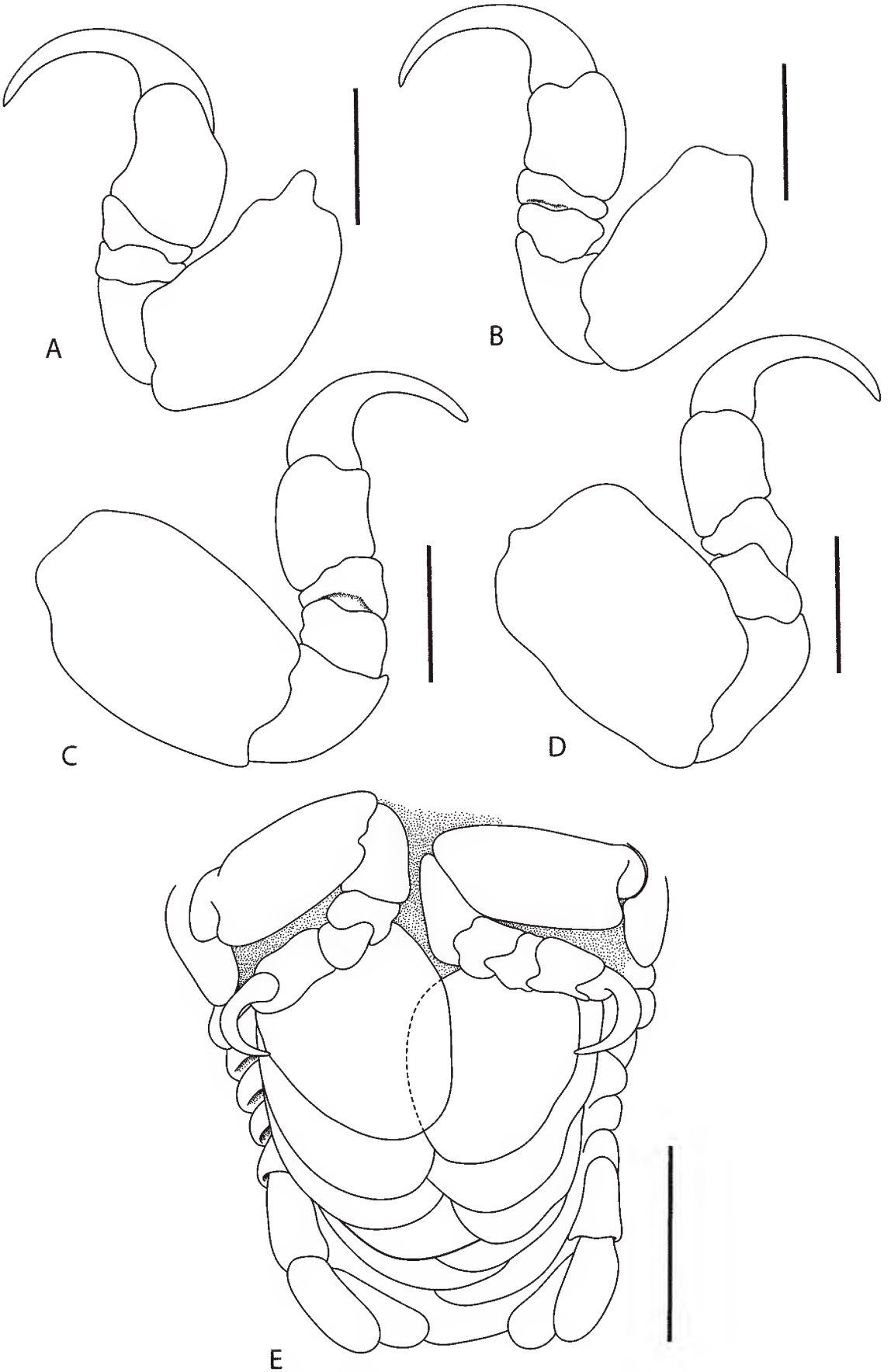

Figure 4. *Smenispa irregularis,* male (9 mm) (AM P89833). *(A–D)* pereopod 1, 2, 6, 7 respectively; *(E)* ventral view of pleotelson. Scales: A–D= 0.25 mm; E = 1 mm.

Figure 5. *Smenispa irregularis*, male (9 mm) (AM P89833). *(A–E)* pleopod 1–5 respectively. Scales = 0.25 mm.

Distribution. *Smenispa irregularis* (Bleeker, 1857) was recorded from Ambon Island (Bleeker, 1857), Singapore and Thailand (Schioedte & Meinert, 1884), Jakarta Bay (Trilles, 1979), Arafura Sea, Northern Territory (Bruce, 1990) and present material is from Carnarvon, Western Australia (Fig. 1).

Remarks. Our current female and male specimens differ from each other in the female having indistinct eyes, the cephalon deeply immersed in pereonite 1; pereonite 1 anterolateral margin well produced and posterior margin of pereonite 7 well developed.

The body shape of the female syntypes (Bruce, 1990, fig. 24) differ slightly from that of the Australian specimen also illustrated by Bruce (1990, fig. 25) and also from that of the present material. The syntype female cephalon has an irregular and rounded cephalon deeply embedded in pereonite 1; the posterolateral margins of pereonite 1–3 are deeply convex; the posterior margin of pereonite 7 is well developed, laterally overlapping pleonite 1; pereonite width 5 1.5 times pleon width; coxae 5–7 are short ("compact") and do not extend to the posterior margins of their respective pereonite, moderately rounded uropod rami apices and rounded pleotelson posterior margin. The Australian specimens from Carnarvon and Bruce's (1990) specimen differ from the syntypes in having a subquadrate cephalon (compared to the rounded cephalon), the posterior margin of pereonites 1–3 are subequal in width (compared to the progressive posterior margin width of pereonites 1–3), pereon and pleon are co-linear with sub-parallel lateral margins, both uropod rami apices rounded (compared to the rounded endopod and sub-truncate exopod) and subquadrate pleotelson posterior margin (compared to the smooth and rounded pleotelson).

Smenispa irregularis is known to occur on host species from the family Sparidae, Carangidae and Psettodidae, suggesting the species has low host specificity. The current host *Acanthopagrus latus* is a schooling species that occurs in the Indo-West Pacific (Froese & Pauly, 2013).

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